

(12) UK Patent Application (19) GB (11) 2 371 091 (13) A

(43) Date of A Publication 17.07.2002

(21) Application No 0100828.3

(22) Date of Filing 12.01.2001

(71) Applicant(s)  
Scroll Technologies  
(Incorporated in USA - Delaware)  
One Scroll Drive, Clark County Industrial Park,  
Arkadelphia, Arkansas 71923,  
United States of America

(72) Inventor(s)  
John R Williams  
Tracy Milliff  
Gene Michael Fields  
Thomas R Barito

(74) Agent and/or Address for Service  
Cruikshank & Fairweather  
19 Royal Exchange Square, GLASGOW, G1 3AE,  
United Kingdom

(51) INT CL<sup>7</sup>  
F04C 18/02 23/00 29/00

(52) UK CL (Edition T )  
F1F FD FEU F1A7

(56) Documents Cited  
EP 0656477 A JP 570131895 A  
JP 100281083 A JP 100153186 A  
JP 090329091 A JP 070158567 A  
US 5222881 A

(58) Field of Search  
UK CL (Edition S ) F1F FD FEU  
INT CL<sup>7</sup> F01C , F04C  
Online databases: EPODOC, JAPIO, WPI

(54) Abstract Title  
Counterweight for reduced height sealed compressor

(57) A sealed compressor 20, such as a scroll compressor, has a pump unit 22,24 driven via a shaft 26 by a motor 28, with a counterweight 34 mounted between the motor and the pump on the shaft. The counterweight 34 has a neck portion 36 mounted on the shaft, and a relatively thin portion 38 which extends axially from the neck 36 towards the pump unit, utilising the limited space in the reduced height compressor whilst providing a centre of gravity towards the pump unit. The profile of the counterweight 34 may be formed with a backdraft (52, Fig 3B) to resist lubricant from climbing up the axially extending portion 38, or it may be formed with an air foil angle (50,54,56, Fig 4) to control the flow of fluids within the sealed compressor.

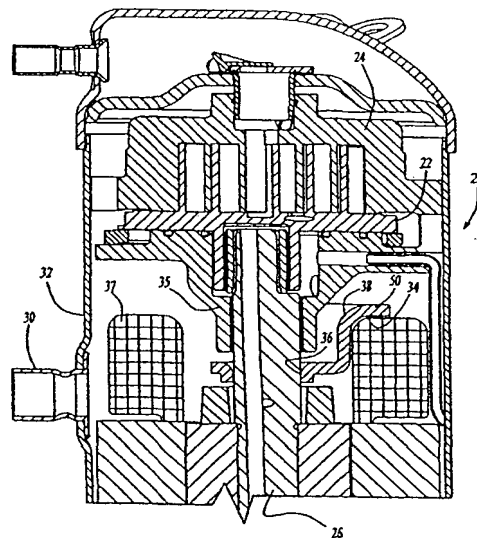


Fig-1

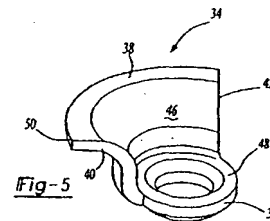


Fig-5

GB 2 371 091 A

1/2

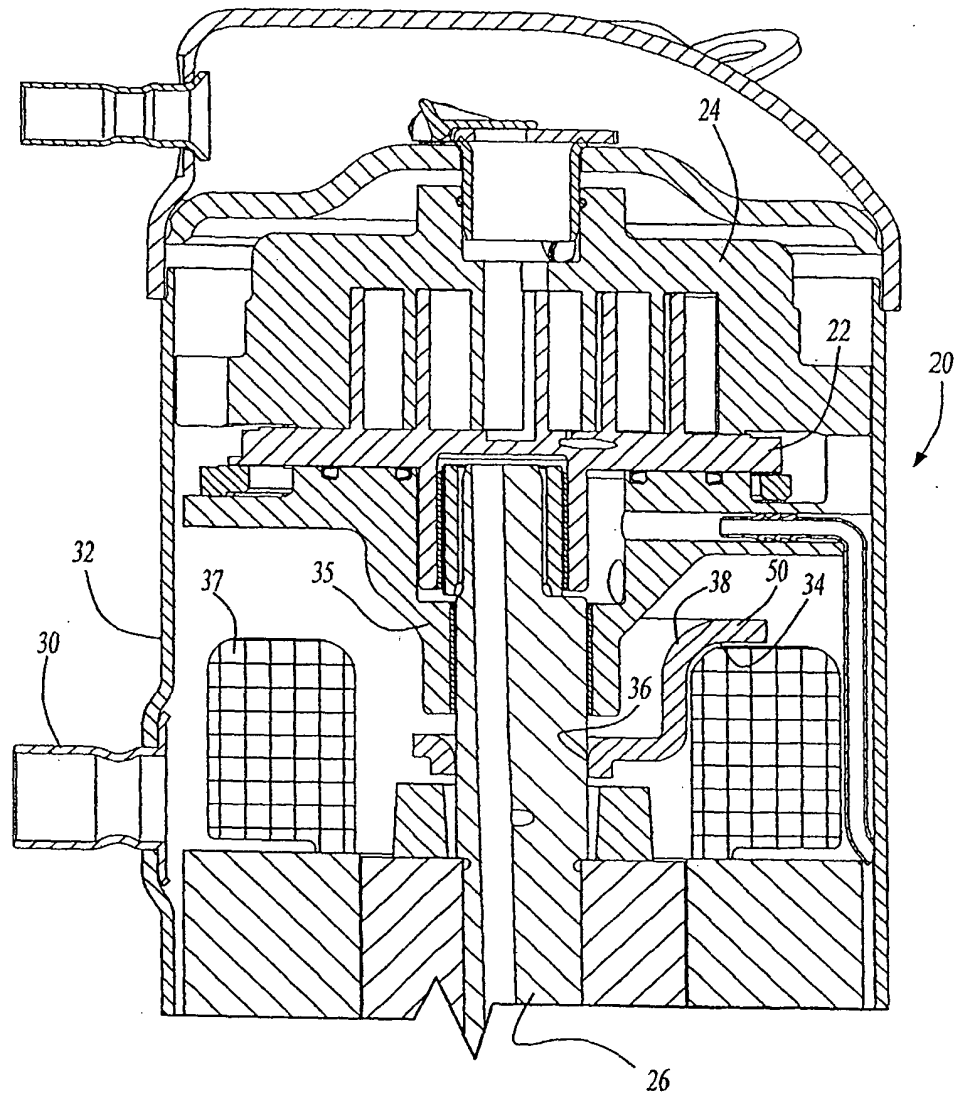


Fig-1

2/2

Fig-2

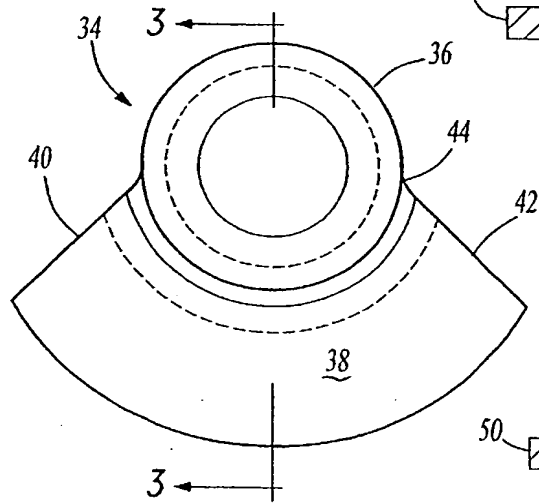


Fig-3A

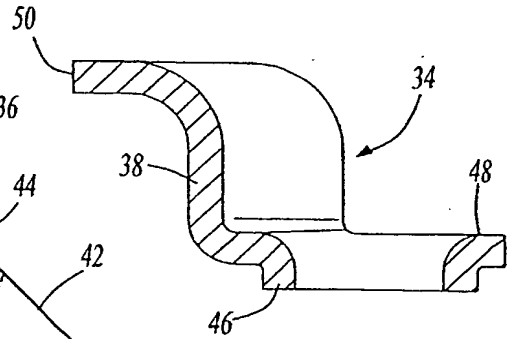


Fig-3B

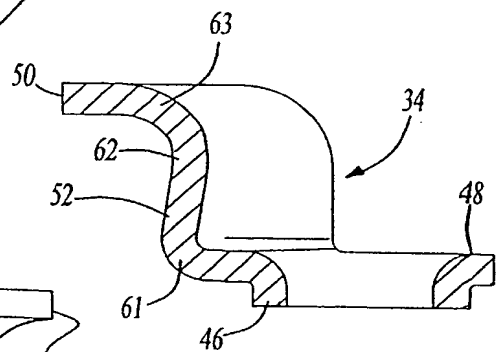


Fig-4

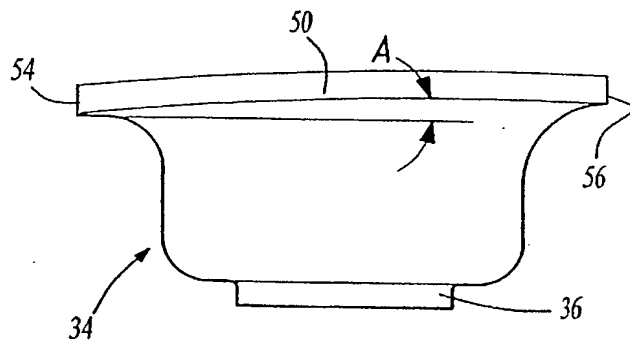
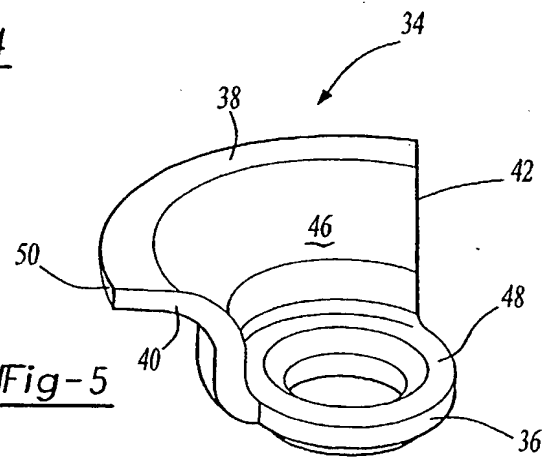


Fig-5



**THIN COUNTERWEIGHT FOR SEALED COMPRESSOR****BACKGROUND OF THE INVENTION**

This invention relates to an improved counterweight for a sealed compressor  
5 wherein the counterweight is relatively thin, allowing the entire sealed compressor housing to be made shorter.

Sealed compressors are utilized in many refrigerant compression applications. In such applications, a housing seals a compressor pump unit and a motor for driving the pump unit. Typically, the motor is maintained in a chamber  
10 which is at a suction pressure such that the motor is cooled. A shaft is driven by the motor to drive at least one element of the compressor pump unit.

In one very popular type of modern compressor, the pump unit consists of two relatively orbiting scroll members. In this type of compressor, known as a scroll compressor, first and second scroll members each have a base and a generally  
15 spiral wrap extending from the base. The spiral wraps interfit to define compression chambers. The shaft drives one of the scroll compressors to orbit relative to the other. As the two scroll members orbit, the size of the compression chambers is decreased to compress an entrapped refrigerant.

Historically, the counterweight has been contained within the geometry of the  
20 upper motor windings, and sandwiched between the crankcase and the motor stator.

A scroll compressor requires a counterweight be mounted onto the shaft. Historically, counterweights have been relatively large parts which extend for a relatively great area and axial length. It is important that a portion of the counterweight, and in particular its center of gravity, be positioned upwardly near to  
25 the orbiting scroll. This has resulted in an undesirable amount of space being required for the counterweight.

**SUMMARY OF THE INVENTION**

In the disclosed embodiment of this invention, the counterweight is a  
30 relatively thin part. In particular, the counterweight has a relatively small neck portion to be received on the shaft, and extending upwardly between the crankcase hub and the upper stator windings to a upper portion which is also relatively thin. The distance that the upper portion extends axially is preferably greater than two

times the thickness of the upper portion and most preferably more than three times the thickness. More preferably, the distance is greater than five times the thickness of the upper portion. This relatively thin counterweight can thus fit into a relatively small amount of space. As will be shown in the drawings, this allows a dramatic  
5 decrease in the required axial length of the sealed compressor.

In other aspects of this invention, the use of the relatively thin counterweight allows the counterweight to be stamped. Once the counterweight is stamped, further features can be quickly provided by easily manipulating the structure of the counterweight. As an example, a back draft can be formed in the counterweight  
10 such that the upper portion is resistant to flow of lubricant upwardly along the outer edge of the counterweight.

Further, the upper edge can be formed to have an air foil angle that may be tailored to assist in oil or refrigerant circulation.

These and other features of the present invention can be best understood from  
15 the following specification and drawings, the following of which is a brief description.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

Figure 1 is a cross-sectional view of a scroll compressor incorporated in the  
20 present invention.

Figure 2 is a top view of an inventive counterweight.

Figure 3A is a cross-sectional view along line 3-3 as shown in Figure 2.

Figure 3B is an alternative embodiment.

Figure 4 is an outer view of one portion of the inventive counterweight.  
25

#### **DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT**

A compressor 20 is illustrated in Figure 1 having an orbiting scroll 22 and a fixed or non-orbiting scroll 24. As known, a shaft 26 drives the orbiting scroll 22 to orbit relative to the non-orbiting scroll. A motor 28 drives the shaft. The orbiting  
30 scroll is driven to orbit by the rotating shaft due to a coupling which causes orbiting movement.

A suction tube 30 extends into a housing 32 which seals the motor and scroll compressor. As shown in the drawing, one recent improvement to sealed

compressors has been the movement of the suction tube 30 downwardly such that is axially aligned to the portion of the motor.

This invention provides the incorporation of the counterweight 34 such that it best utilizes the space available between a crankcase 35 which supports the shaft 26  
5 and orbiting scroll 22, and the upper windings 37 of the motor 28. As can be appreciated from Figure 1, the counterweight 34 is able to best utilize the space between the crankcase 35 and the windings 37, and is thus able to allow a dramatic decrease in the overall length of the compressor.

As can be appreciated from Figure 1, along an axis defined by the rotation of  
10 shaft 26, the counterweight 34 has portions axially aligned with the windings 37, and with the crankcase 35.

The counterweight 34 has a neck portion 36 which is mounted on the shaft 26. Further, the counterweight has an upwardly extending portion 38. The upwardly extending portion 38 moves the center of gravity upwardly away from the  
15 neck portion 36. Thus, even though the counterweight is mounted downwardly within the length of the motor, the center of gravity is upward closer to the orbiting scroll 22, which is the source of imbalance. This allows a lower counterweight, which must balance the upper counterweight, to be made lighter. Thus, the entire counterweight system is of reduced weight.

As can be appreciated from Figure 2, the counterweight 34 has its upper  
20 portion 38 extending between two circumferential ends 40 and 42. In the preferred embodiment, these ends are spaced by about 90 degrees. Further, a blend portion 44 is formed at an angle between the neck portion 36 and leading into the upper portion 38. A central bore 46 is fitted onto the shaft 26.

As one main benefit of the stamped thin metal counterweight of this  
25 invention, the bore 46 is able to have a loose dimension tolerance due to material ductility. The bore will yield as forced onto the shaft 26, and thus tight tolerance control is not necessary. This allows a dramatic reduction in cost.

As shown in Figure 3A, the neck portion 46 has the downwardly extending  
30 portion 46 which is received on the shaft, and an outwardly extending ear portion 48. Ear portion 48 leads into the blend portion 44 as can be appreciated in Figure 2. An outer edge 50 of the upper portion 38 is defined at the radially outermost and

axially uppermost location of the counterweight. As can be appreciated from Figure 1, portion 50 extends radially outwardly above the motor windings 37.

As shown in an alternative embodiment 51 in Figure 3B, a backdraft 52 may be formed on the upper portion 38. The backdraft 52 comprises a first section 61  
5 extending radially outwardly and a section 62 extending back inwardly. An upper extreme 63 of upper portion 38 extends radially outwardly of section 62. The backdraft 52 will resist "crawling" or climbing of lubricant up the wall of the counterweight. This will better control lubricant flow. In another feature  
apparent from Figures 3A and 3B, the counterweight is relatively thin. As can be  
10 appreciated, the upper portion extends for a distance that is more than two and preferably three times the thickness of the upper portion. Further, more preferably, the upper portion extends for an axial length that is greater than five times the thickness of the upper portion. In one preferred embodiment, the upper portion  
extended axially for a distance that is 38.15mm, while the upper portion had a  
15 thickness of 7.137mm. The relatively thin counterweight is able to provide a very compact design that is able to fit within the tight space requirements of an axially height reduced compressor.

As shown in Figure 4, in another feature, the outer edge 50 of the upper  
portion can be formed to create an air foil angle A. One end 54 of the outer edge 50  
20 can be positioned downwardly relative to the opposed end 56. As shown, the edge does not extend along a straight line, but is preferably curved. During rotation, this air foil angle will control the flow of fluids within the sealed compressor. The air flow angle can be utilized to improve gas and oil circulation, or to control suction  
gas flow.

25 The counterweight is preferably stamped from a suitable metal, and preferably from steel.

A preferred embodiment of this invention has been disclosed, however, a  
worker in this art would recognize that certain modifications would come within the  
scope of this invention. For that reason, the following claims should be studied to  
30 determine the true scope and content of this invention.

## **CLAIMS**

1. A compressor comprising:  
a compressor pump unit mounted at one end;  
5 a motor for driving said compressor pump unit, said motor driving a shaft, said shaft being mounted to drive at least a portion of said compressor pump unit; and  
a counterweight mounted on said shaft, said counterweight being positioned between an upper edge of said motor and a lower edge of said compressor pump unit, said counterweight being relatively thin, and said  
10 counterweight having a neck portion mounted on said shaft, and an upper portion extending upwardly from said neck portion toward said compressor pump unit, said upper portion extending for less than 360° of circumference about a rotational axis of said shaft, and said upper portion extending axially  
15 from said neck portion for a length that is more than two times the thickness of said upper portion.
2. A compressor as recited in Claim 1, wherein said upper portion extends for a length that is greater than five times the thickness of said neck  
20 portion.
3. A compressor as recited in Claim 1, wherein said counterweight is formed as a stamped metal part.
- 25 4. A compressor as recited in Claim 3, wherein said counterweight is formed of a steel.
5. A compressor as recited in Claim 1, wherein said neck portion has a  
30 downwardly extending tubular portion to be received on a shaft and an outwardly extending ear portion, said outwardly extending ear portion merging into said upper portion.



- 5           6.     A compressor as recited in Claim 1, wherein said upper portion has a backdraft portion created by a portion of said upper portion curving radially outwardly from said neck portion, and then extending back radially inwardly, said backdraft portion resisting flow of lubricant within a housing receiving said compressor.
- 10           7.     A compressor as recited in Claim 6, wherein said upper portion including an outer edge extending radially outwardly from said radially inwardly extending portion.
8.     A compressor as recited in Claim 7, wherein said upper portion including a radially outermost edge extending radially outwardly from a portion of said upper portion extending generally axially.
- 15           9.     A compressor as recited in Claim 8, wherein said outer edge provides an air foil by being formed to extend about an angle toward one axial direction such that an air foil is created.
- 20           10.    A compressor as recited in Claim 8, wherein said outer edge extends radially over stator windings of said motor.
- 25           11.    A compressor as recited in Claim 1, wherein said compressor pump unit is a scroll compressor comprising first and second scroll members each having a base and a generally spiral wrap extending from said base.

12. A compressor comprising:

a compressor pump unit comprising first and second scroll members, each of said first and second scroll members having a base and generally spiral wrap extending from said base, said second scroll member being caused to orbit relative to said first scroll member, and said wraps interfitting to define compression chambers;

a motor for driving said second scroll member, said motor driving a shaft, said shaft driving said second scroll member; and

a counterweight mounted on said shaft, said counterweight being positioned between upper edge of said motor and a lower edge of said compressor pump unit, said counterweight being relatively thin, and said counterweight having a neck portion mounted on said shaft, and an upper portion extending upwardly from said neck portion toward said compressor pump unit, said upper portion extending for less than 360° of circumference about a rotational axis of said shaft, and said upper portion extending axially from said neck portion for a length that is more than three times the thickness of said upper portion.

13. A compressor as recited in Claim 12, wherein said upper portion extends for a length that is greater than five times the thickness of said neck portion.

14. A compressor as recited in Claim 12, wherein said counterweight is formed as a stamped metal part.

15. A compressor as recited in Claim 12, wherein said neck portion has a downwardly extending tubular portion to be received on a shaft and an outwardly extending ear portion, said outwardly extending ear portion merging into said upper portion.

16. A compressor as recited in Claim 12, wherein said upper portion has a backdraft portion created by a portion of said upper portion curving radially outwardly from said neck portion, and then extending back radially inwardly, said backdraft portion resisting flow of lubricant within a housing receiving said compressor.

17. A compressor as recited in Claim 16, wherein said upper portion including an outer edge extending radially outwardly from said radially inwardly extending portion.

18. A compressor as recited in Claim 12, wherein said upper portion including a radially outermost edge extending radially outwardly from a portion of said upper portion extending generally axially.

19. A compressor as recited in Claim 18, wherein said outer edge provides an air foil by being formed to extend about an angle toward one axial direction such that an air foil is created.

20. A compressor as hereinbefore described with reference to Figures 1, 2 and 3, 3B and 4.



Application No: GB 0100828.3  
Claims searched: 1 & 12

Examiner: Robert Crowshaw  
Date of search: 15 May 2001

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:  
UK CI (Ed.S): F1F (FD, FEU)  
Int CI (Ed.7): F01C; F04C  
Other: Online databases: EPODOC, JAPIO, WPI

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	EP 0656477 A (TOYODA) See the counterweight 13 in figs 1-3.	1, at least
X	US 5222881 (MITSUBISHI) See the counterweight 14 in fig 17.	1 & 12, at least
X	JP 100281083 A (MITSUBISHI) 1998-10-20. See WPI Abstract Accession No 1999-006499[01] and the counterweight 5 in the figure.	1 & 12, at least
X	JP 100153186 A (HITACHI) 1998-06-09. See WPI Abstract Accession No 1998-381870[33], and the counterweight 22 in the figures.	1, at least
X	JP 090329091 A (DAIKIN) 1997-12-22. See WPI Abstract Accession No 1998-105650[10] and the counterweight 41 in the figure.	1, at least
X	JP 070158567 A (NIPPONDENSO) 1995-06-20. See JAPIO abstract and the counterweight 9 in the figure.	1, at least
X	JP 570131895 A (MITSUBISHI DENKI) 1982-08-14. See JAPIO abstract and the counterweight in the figures.	1 & 12, at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.